Data Center Energy Efficiency
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Data Center Energy Efficiency Topics

- Impact of Moore's Law
- Harvesting the low hanging fruit
  - Bypass Airflow losses

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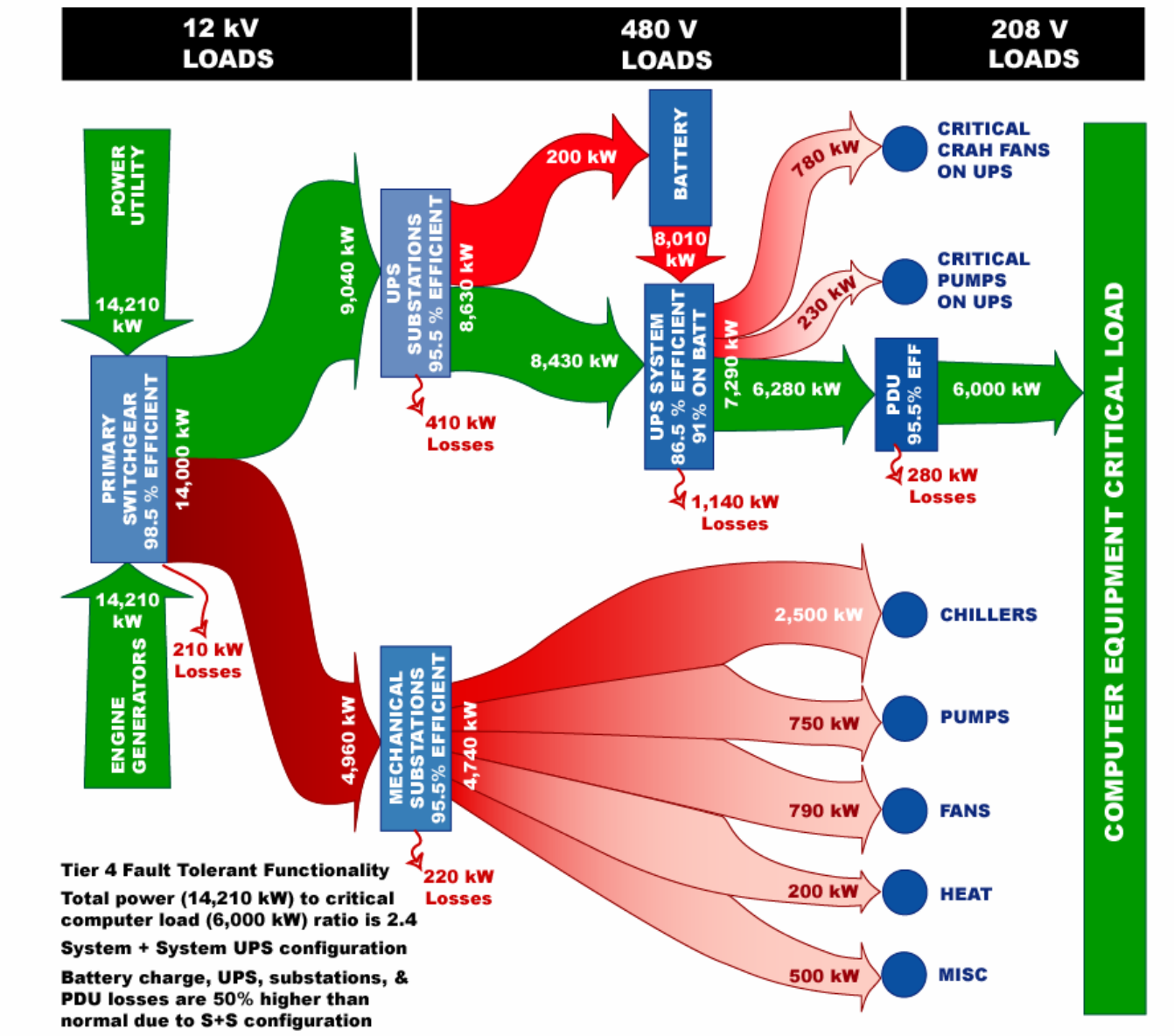
Impact of Moore's Law On IT Power Consumption

- Cost per processor is decreasing at 29% per yr
- Constant dollars spent on high performance IT hardware three years from now will buy
  - 2.7 times more processors
  - 12 times more processing power in the same or less floor space
  - 3.3 times increase in UPS power consumption
- **Site power consumption increases at least 2x the UPS power consumption increase**

Data Center Power Flow



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Coefficient of Data Center Energy Efficiency

- Coefficient of Efficiency = Total power required to operate computer room / critical power
  - Ideal = 1.6
  - Goal = 2.0
  - Average = 2.4
  - Worst case = 3+
- As Coefficient worsens, likelihood of poor environment (input air hot spots) increases
  - At 2.4 kW per cabinet (average), 10% of cabinets exceed recommended air intake temperature
  - At 3 kW+, 25% of cabinets can be too hot

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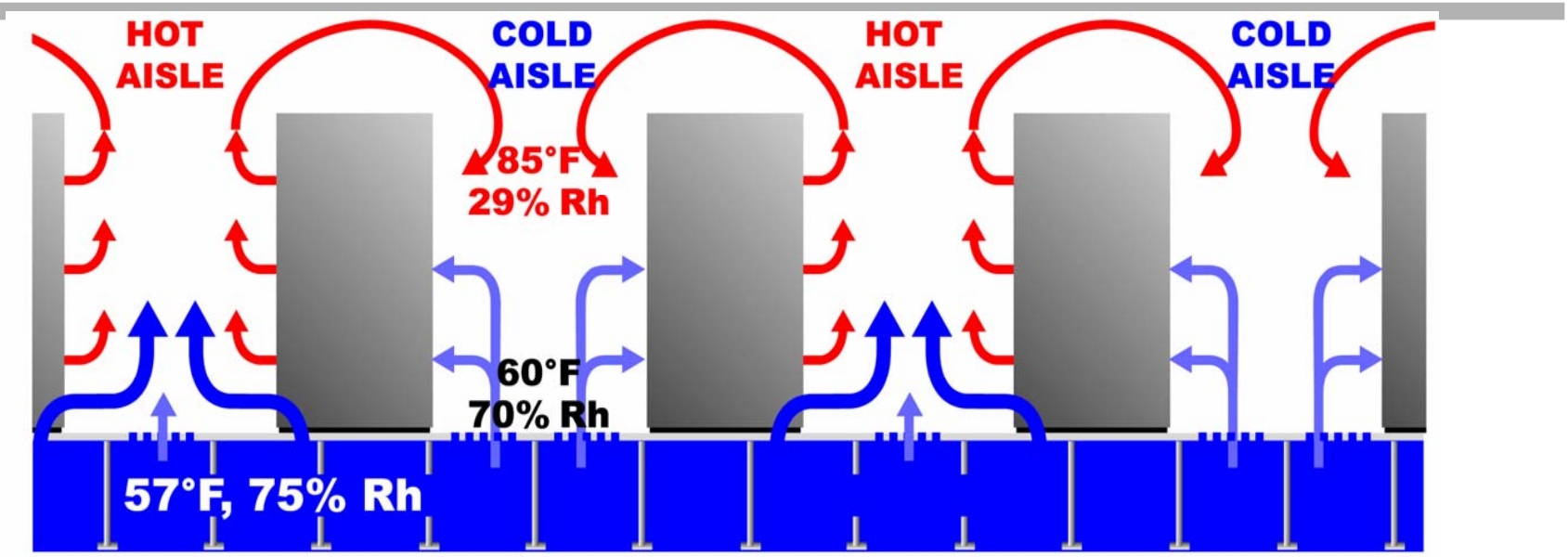
Bypass Airflow Definition

- Conditioned air is not getting to the air intakes of computer equipment
  - Escaping through cable cutouts and holes under cabinets
  - Escaping through misplaced perforated tiles
  - Escaping through holes in computer room perimeter walls, ceiling, or floor

Computer Room Layout Options
Effect of Bypass Airflow



- Cold air escapes through cable cutouts
- Escaping cold air reduces static pressure resulting in insufficient cold aisle airflow
- Result is vertical and zone hot spots in high heat load areas

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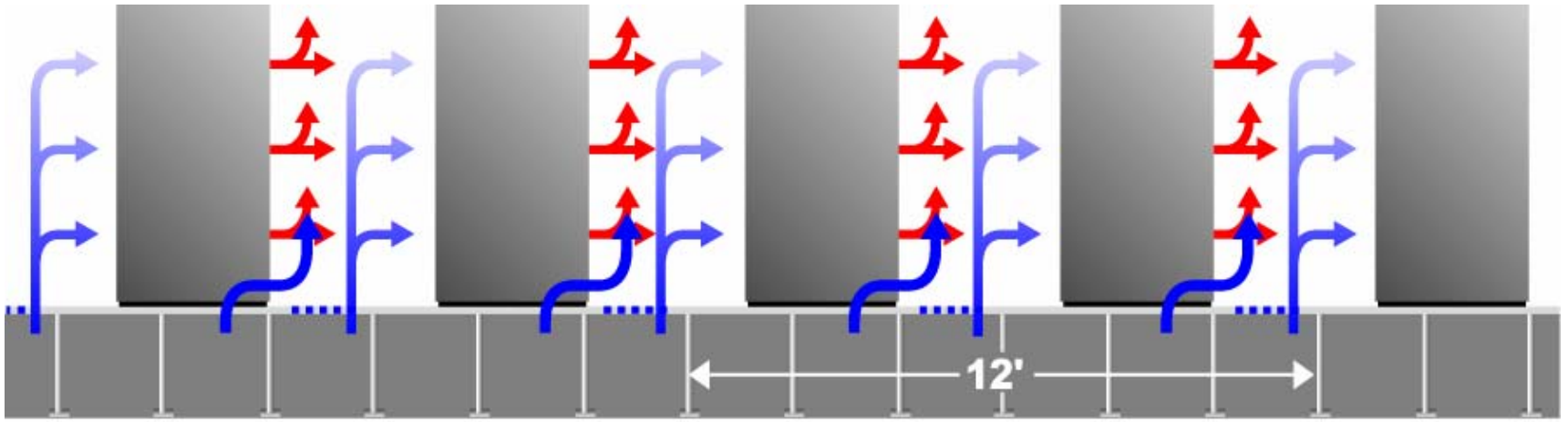
Raised-Floor Utilization
Traditional Layout



- All aisles have elevated “mixed” temperature (starved supply airflow compounds problem)
- Fails to deliver predictable air intake temperatures
- Reduces return air temperature which reduces cooling unit capacity and removes moisture
- Removed moisture must be reinserted into the computer room

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Bypass Airflow
Is It a Problem?

- 72% of available cold air is short cycling back to cooling units through perforated tiles in the hot aisle and unsealed cable openings
  - Based on detailed measurements in 19 computer rooms totaling 204,400 ft^2
  - Despite 2.6 times more cooling running than was required by the heat load, 10% of racks had air intake temperatures exceeding *ASHRAE* maximum reliability guidelines (rooms with greatest excess cooling capacity running had worst hot spots)

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Bypass Airflow Incapacity Penalty

- At 72°F @ 45% Rh
  - 67 kWc sensible capacity
- At 70°F @ 48% Rh
  - 64 kWc total cooling capacity
    - 59 kWc sensible capacity
    - 5 kWc latent capacity

- Latent Cooling Penalty = $6.4K / Year / Cooling Unit assuming energy cost of $0.06 / kWh

Bypass Airflow
How Is It Fixed?

- Seal all the holes in the computer room perimeter
- Seal all openings in the raised floor (cables, PDUs and cooling units, floor edges, cutouts for pipes, etc.)
- Install blanking plates in all unused spaces in equipment racks and cabinets

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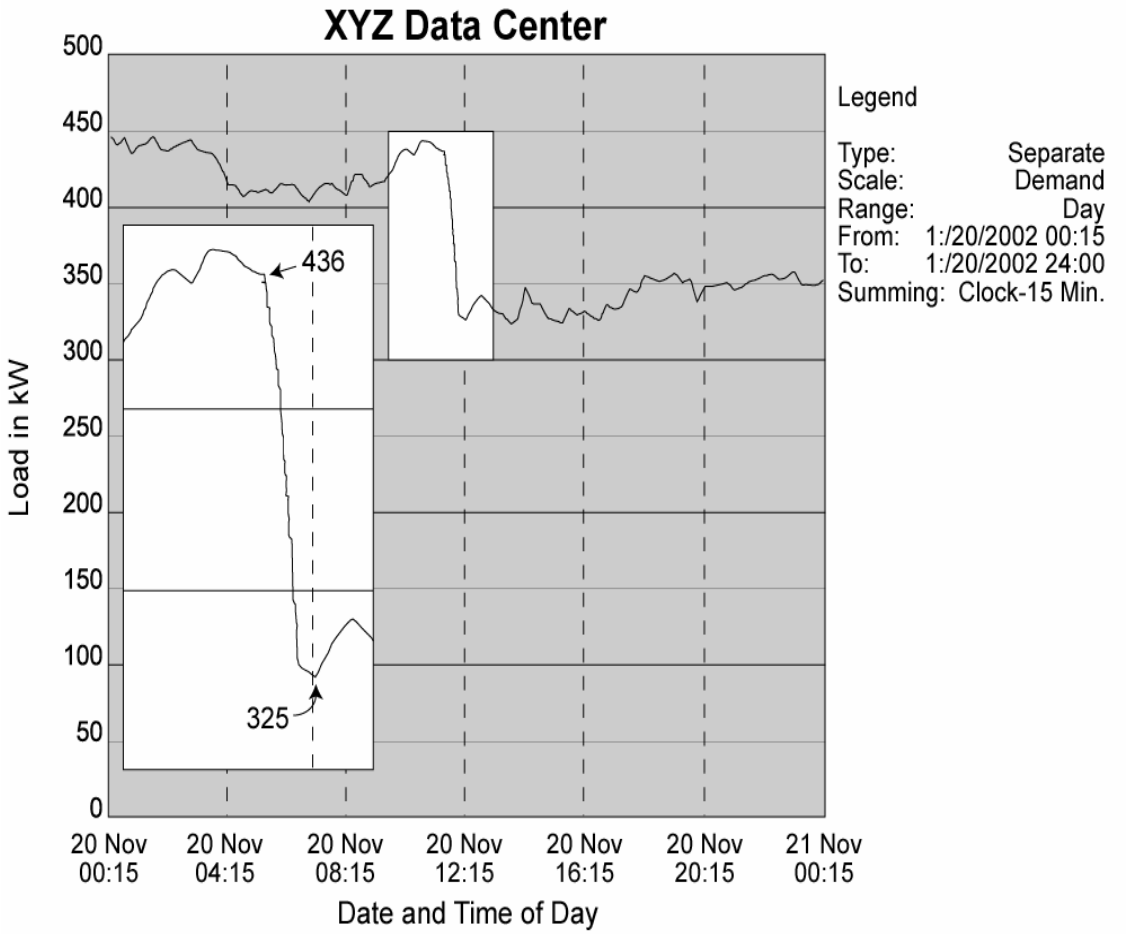
“Real World” Data Center Energy Losses

Despite running 24 cooling units for a five-unit heat load, this site had numerous hot spots. Turning off 11 units eliminated the hot spots and reduced energy consumption by 25%.



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More Information

- koldlok.com
- upsite.com
- High-Density Computing Symposium & Exhibition, April 23 – 26, 2006, Orlando, FL

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